PENDING CLAIMS (PART ONE)

There are no claim amendments if the preceding Remarks of Part One are persuasive; for reference, a listing of the pending claims follows.

1. (previously amended) A sonar system, comprising:

a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field.

2. (original) A sonar system, comprising:

a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and each channel processed through a cochlear processor and an envelope processor, and the outputs of such channels are further processed by a shape from latency processor, a stereausis processor, and an object recognition processor to generate acoustic images and probable identification of objects in the ensonified field.

3. (original) A sonar system, comprising:

a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes from one or more ensonified objects are received by the receiver and each channel is processed through a cochlear processor and then an envelope processor, the output of each envelope processor is further processed by a shape from latency processor, a second output of each cochlear processor is processed by a stereausis processor, a third output of each cochlear processor is processed by an object recognition processor that contains a library of object templates, a template comparator, an end user interface, and a neural

network, and in which object recognition processor the echolocation data describing one or more ensonified objects that is output from the shape from latency processor, the two or more cochlear processors, and the stereausis processor are processed by the neural network to generate acoustic images, the generated images are compared by the template comparator with object templates in the object template library for identification, and probable identifications of the one or more ensonified objects are provided through the neural network to the end user interface.

4. (original) The system of Claims 1, 2, or 3, in which the transmitter and receiver are housed in an enclosure, a transmitter hydrophone and two receiver hydrophones are located on a front panel of the enclosure and in contact with an ensonified medium, the transmitter hydrophone center is located approximately 10 cm above the centerline of, and midway between, the two receiver hydrophones, and the two receiver hydrophones are centered approximately 13 cm apart.

5. (original) The system of Claims 1, 2, or 3, in which the acoustic pulses transmitted by transmitter are replicas of the projector modulation, beamwidth, and waveforms used by *Tursiops truncatus.*

6. (original) The system of Claims 1, 2, or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and auditory processing in the receiver closely approximates that used by *Tursiops truncatus.*

7. (original) The system of Claims 1, 2, or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the generation of neural signals and processing by a neural network.

8. (original) The system of Claims 1, 2, or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the generation of two and three dimensional acoustic images of the ensonified objects.

9. (original) The system of Claims 1, 2, or 3, in which a hydrophone used by the transmitter is connected through a switch to a third receive channel in the receiver, the use of the transmitter

hydrophone is switched between a transmit channel during transmission of acoustic pulses for radiation by the transmitter and the third receive channel during the time between the transmission of acoustic pulses, echoes of ensonified objects in the field of the transmitter are received by the receiver, and three channels of processing are used in the receiver.

10. (original) The system of Claims 1, 2, or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver characterizes an ensonified object's surface, structure, thickness, and geometry by ensonifying the object from a plurality of aspects and processing the echoes of the object.

11. (original) The system of Claims 1, 2, or 3, in which processing in the receiver is performed by neural networks.

12. (original) The system of Claims 1, 2, or 3, in which two or more of such systems are linked by data communications and used concurrently to provide more information about an ensonified object, navigation, or process being controlled, to provide a more rapid identification of an ensonified object, or to cover a greater ensonified area.

13. (original) The system of Claims 1, 2, or 3, in which two or more of such systems are linked by data communications and a transmitter frequency control system that prevents concurrent use by more than one transmitter of a given frequency band.

14. (previously amended) A method of using the system of Claims 1, 2, or 3, to identify submerged objects, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images and probable identification of objects in the ensonified field.

15. (previously amended) A method of using the system of Claims 1, 2, or 3, to identify objects buried under water, comprising:

ensonifying an underwater field, including a bottom surface of the body of water, with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images and probable identification of buried objects in the ensonified field.

16. (previously amended) A method of using the system of Claims 1, 2, or 3, for underwater navigation, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate navigation in the ensonified field.

17. (previously amended) A method of using the system of Claims 1, 2, or 3, for underwater process control, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate process control in the ensonified field.

18. (previously amended) A method of using the system of Claims 1, 2, or 3, for underwater rescue or salvage operations, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate rescue or salvage operations in the ensonified field.

19. (previously amended) A method of using the system of Claims 1, 2, or 3, for process control in atmospheric environments where lighting is unavailable, comprising:

ensonifying an atmospheric field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate process control in the ensonified field.

20. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and binaural processing in the receiver includes the step of emulating the displacement by acoustic energy of a basilar membrane in *Tursiops truncatus* by the use of a gammatone filter bank in a left cochlear processor and a right cochlear processor.

21. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the step of emulating the displacement by acoustic energy of a basilar membrane in *Tursiops truncatus* by the use of a gammatone filter bank in a left cochlear processor and a right cochlear processor, and the bandpass and skirts of the gammatone filters in each gammatone filter bank are dynamically changed to optimize the acoustic image generated.

22. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the steps in each cochlear processor of log transforming received signals, and adding the Hilbert transform of the signal to itself in each envelope processor, to construct envelopes of received signals that facilitate extraction of the temporal characteristics of a given echo.

23. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes selecting filter center frequencies, filter bandpass, filter shape, and number of filters in a gammatone filter bank in the cochlear processors to emulate the functioning of a basilar membrane in *Tursiops truncatus* and thereby to optimize the acoustic image generated.

24. (original) The system of Claims 2 or 3 in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver generates acoustic images that contain detailed temporal information about the structure of the echo, broad spectral estimations, and detailed phase information for use within a processor in a receive channel and in combining signals from more than one processor.

25. (original) The system of Claims 2 or 3 in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver employs lateral inhibition by transmission of a neural activation pattern in the cochlear processor through a set of partially overlapping receptive fields made up of 2-dimensional Difference of Gaussians filters.

26. (original) The system of Claims 2 or 3 in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver compares an acoustic image of an ensonified object with object templates, provides one or more probability-weighted identifications of the ensonified object based on the closest one or more matches of the acoustic image with one or more object templates.

PART TWO: AMENDMENT OF THE CLAIMS

If the Remarks of Part One are unpersuasive, please cancel claim 1, amend claims 4 to 20, and add claims 27 to 42, as shown below.

1. (cancelled)

2. (original) A sonar system, comprising:

a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and each channel processed through a cochlear processor and an envelope processor, and the outputs of such channels are further processed by a shape from latency processor, a stereausis processor, and an object recognition processor to generate acoustic images and probable identification of objects in the ensonified field.

3. (original) A sonar system, comprising:

a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes from one or more ensonified objects are received by the receiver and each channel is processed through a cochlear processor and then an envelope processor, the output of each envelope processor is further processed by a shape from latency processor, a second output of each cochlear processor is processed by a stereausis processor, a third output of each cochlear processor is processed by an object recognition processor that contains a library of object templates, a template comparator, an end user interface, and a neural network, and in which object recognition processor the echolocation data describing one or more ensonified objects that is output from the shape from latency processor, the two or more cochlear processors, and the stereausis processor are processed by the neural network to generate acoustic images, the generated images are compared by the template comparator with object templates in the object template library for identification, and probable identifications of

the one or more ensonified objects are provided through the neural network to the end user interface.

4. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which the transmitter and receiver are housed in an enclosure, a transmitter hydrophone and two receiver hydrophones are located on a front panel of the enclosure and in contact with an ensonified medium, the transmitter hydrophone center is located approximately 10 cm above the centerline of, and midway between, the two receiver hydrophones, and the two receiver hydrophones are centered approximately 13 cm apart.

5. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which the acoustic pulses transmitted by transmitter are replicas of the projector modulation, beamwidth, and waveforms used by *Tursiops truncatus*.

6. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and auditory processing in the receiver closely approximates that used by *Tursiops truncatus*.

7. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the generation of neural signals and processing by a neural network.

8. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the generation of two and three dimensional acoustic images of the ensonified objects.

9. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which a hydrophone used by the transmitter is connected through a switch to a third receive channel in the receiver, the use of the transmitter hydrophone is switched between a transmit channel during transmission of acoustic pulses for radiation by the transmitter and the third receive channel during the time between the transmission of acoustic pulses, echoes of ensonified objects in the field of the transmitter are received by the receiver, and three channels of processing are used in the receiver.

10. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver characterizes an ensonified object's surface, structure, thickness, and geometry by ensonifying the object from a plurality of aspects and processing the echoes of the object.

11. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which processing in the receiver is performed by neural networks.

12. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which two or more of such systems are linked by data communications and used concurrently to provide more information about an ensonified object, navigation, or process being controlled, to provide a more rapid identification of an ensonified object, or to cover a greater ensonified area.

13. (currently amended) The system of Claims [[1,]] 2[[,]] or 3, in which two or more of such systems are linked by data communications and a transmitter frequency control system that prevents concurrent use by more than one transmitter of a given frequency band.

14. (currently amended) A method of using the system of Claims [[1,]] 2[[,]] or 3, to identify submerged objects, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images and probable identification of objects in the ensonified field.

15. (currently amended) A method of using the system of Claims [[1,]] 2[[,]] or 3, to identify objects buried under water, comprising:

ensonifying an underwater field, including a bottom surface of the body of water, with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images and probable identification of buried objects in the ensonified field.

16. (currently amended) A method of using the system of Claims [[1,]] 2[[,]] or 3, for underwater navigation, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate navigation in the ensonified field.

17. (currently amended) A method of using the system of Claims [[1,]] 2[[,]] or 3, for underwater process control, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate process control in the ensonified field.

18. (currently amended) A method of using the system of Claims [[1,]] 2[[,]] or 3, for underwater rescue or salvage operations, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate rescue or salvage operations in the ensonified field.

19. (currently amended) A method of using the system of Claims [[1,]] 2[[,]] or 3, for process control in atmospheric environments where lighting is unavailable, comprising:

ensonifying an atmospheric field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate process control in the ensonified field.

20. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and binaural processing in the receiver includes the step of emulating the displacement by acoustic energy of a basilar membrane in *Tursiops truncatus* by the use of a gammatone filter bank in a left cochlear processor and a right cochlear processor.

21. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the step of emulating the displacement by acoustic energy of a basilar membrane in *Tursiops truncatus* by

the use of a gammatone filter bank in a left cochlear processor and a right cochlear processor, and the bandpass and skirts of the gammatone filters in each gammatone filter bank are dynamically changed to optimize the acoustic image generated.

22. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the steps in each cochlear processor of log transforming received signals, and adding the Hilbert transform of the signal to itself in each envelope processor, to construct envelopes of received signals that facilitate extraction of the temporal characteristics of a given echo.

23. (original) The system of Claims 2 or 3, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes selecting filter center frequencies, filter bandpass, filter shape, and number of filters in a gammatone filter bank in the cochlear processors to emulate the functioning of a basilar membrane in *Tursiops truncatus* and thereby to optimize the acoustic image generated.

24. (original) The system of Claims 2 or 3 in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver generates acoustic images that contain detailed temporal information about the structure of the echo, broad spectral estimations, and detailed phase information for use within a processor in a receive channel and in combining signals from more than one processor.

25. (original) The system of Claims 2 or 3 in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver employs lateral inhibition by transmission of a neural activation pattern in the cochlear processor through a set of partially overlapping receptive fields made up of 2-dimensional Difference of Gaussians filters.

26. (original) The system of Claims 2 or 3 in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver compares an acoustic image of an ensonified object with object templates, provides one or more probability-weighted identifications of the ensonified object based on the closest one or more matches of the acoustic image with one or more object templates.

27. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which the transmitter and receiver are housed in an enclosure, a transmitter hydrophone and two receiver hydrophones are located on a front panel of the enclosure and in contact with an ensonified medium, the transmitter hydrophone center is located approximately 10 cm above the centerline of, and midway between, the two receiver hydrophones, and the two receiver hydrophones are centered approximately 13 cm apart.

28. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which the acoustic pulses transmitted by transmitter are replicas of the projector modulation, beamwidth, and waveforms used by *Tursiops truncatus*.

29. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and, in which echoes of ensonified objects in the field of the transmitter are received by the receiver and auditory processing in the receiver closely approximates that used by *Tursiops truncatus*.

30. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which echoes of ensonified objects in the field of the transmitter are

received by the receiver and processing in the receiver includes the generation of neural signals and processing by a neural network.

31. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver includes the generation of two and three dimensional acoustic images of the ensonified objects.

32. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which a hydrophone used by the transmitter is connected through a switch to a third receive channel in the receiver, the use of the transmitter hydrophone is switched between a transmit channel during transmission of acoustic pulses for radiation by the transmitter and the third receive channel during the time between the transmission of acoustic pulses, echoes of ensonified objects in the field of the transmitter are received by the receiver, and three channels of processing are used in the receiver.

33. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which echoes of ensonified objects in the field of the transmitter are received by the receiver and processing in the receiver characterizes an ensonified object's surface, structure, thickness, and geometry by ensonifying the object from a plurality of aspects and processing the echoes of the object.

34. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which processing in the receiver is performed by neural networks.

35. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which two or more of such systems are linked by data communications and used concurrently to provide more information about an ensonified object, navigation, or process being controlled, to provide a more rapid identification of an ensonified object, or to cover a greater ensonified area.

36. (new) A sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, and in which two or more of such systems are linked by data communications and a transmitter frequency control system that prevents concurrent use by more than one transmitter of a given frequency band.

37. (new) A method of using a sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, to identify submerged objects, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images and probable identification of objects in the ensonified field.

38. (new) A method of using a sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, to identify objects buried under water, comprising:

ensonifying an underwater field, including a bottom surface of the body of water, with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images and probable identification of buried objects in the ensonified field.

39. (new) A method of using a sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, for underwater navigation, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate navigation in the ensonified field.

40. (new) A method of using a sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, for underwater process control, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate process control in the ensonified field.

41. (new) A method of using a sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are

received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, for underwater rescue or salvage operations, comprising:

ensonifying an underwater field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate rescue or salvage operations in the ensonified field.

42. (new) A method of using a sonar system, comprising a transmitter and receiver that use acoustic signal waveforms and processing similar to those used by dolphins for echolocation in which acoustic pulses are radiated by the transmitter, two or more channels of pulse echoes are received by the receiver and processed to generate acoustic images and probable identification of objects in the ensonified field, for process control in atmospheric environments where lighting is unavailable, comprising:

ensonifying an atmospheric field with acoustic pulses from the transmitter,

processing the pulse echoes received by the receiver, and

generating acoustic images to facilitate process control in the ensonified field.